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ORIGINAL ARTICLE

The Interplay Between Adolescent Friendship Quality and Resilient Functioning Following Childhood and Adolescent Adversity

A.-L. van Harmelen[1,2] · S. J. Blakemore[3,4] · I. M. Goodyer[2] · R. A. Kievit[5,6]

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Abstract

Child and adolescent adversity ('CA') is a major predictor of mental health problems in adolescence and early adulthood. However, not all young people who have experienced CA develop psychopathology; their mental health functioning can be described as *resilient*. We previously found that resilient functioning in adolescence following CA is facilitated by adolescent friendships. However, during adolescence, friendships undergo significant change. It is unknown whether resilient functioning after CA fluctuates with these normative changes in friendship quality. We used Latent Change Score Modelling in a large sample of adolescents (i.e. the ROOTS cohort; $N = 1238$) to examine whether and how emergent friendship quality and resilient functioning at ages 14 and 17 inter-relate and change together. We found that friendships quality and resilient functioning had strong associations at age 14, although friendships at 14 did not predict higher resilient functioning at 17. Higher resilient functioning in 14-year-olds with a history of CA was associated with a positive change in friendships from age 14 to 17. Finally, improvements in friendship quality and resilient functioning went hand-in-hand, even when taking into account baseline levels of both, the change within friendship quality or resilient functioning over time, and the association between resilient functioning and change in friendship quality over time. We show that friendship quality and resilient functioning after CA inter-relate and change together between ages 14 and 17. Our results suggest that improving friendship quality or resilient functioning within this timeframe may benefit this vulnerable adolescent group, and this should be tested in future research.

Keywords Childhood adversity · Resilience · Mental health · Adolescence · Friendships

Abbreviations

CA	Childhood and Adolescent Adversity
PCA	Principle component analysis
SES	Socio-economic status
MFQ	The Mood and Feelings questionnaire
RCMAS	Revised Children's Manifest Anxiety Scale self-report questionnaire
LOI	Short Leyton Obsessional Inventory
CBCL	Child Behaviours Checklist
RRS	Ruminative Response Questionnaire
CAMEEI	Cambridge Early Experiences Interview

Introduction

Adolescence, defined as the period of life between puberty and adult independence, is a time characterised by marked cognitive, hormonal and neuro-developmental maturation as

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✉ A.-L. van Harmelen
a.van.harmelen@fsw.leidenuniv.nl

[1] Education and Child Studies, Leiden University, Leiden, The Netherlands

[2] Department of Psychiatry, University of Cambridge, Cambridge, UK

[3] Department of Psychology, University of Cambridge, Cambridge, UK

[4] UCL Institute of Cognitive Neuroscience, London, UK

[5] Donders Institute for Brain, Cognition and Behaviour, Radboud University Medical Centre, Nijmegen, Netherlands

[6] MRC Cognition and Brain Sciences Unit, University of Cambridge, Cambridge, UK

well as a rapid rise in the incidence of mental health disorders (Blakemore & Mills, 2014; Collishaw, 2015; Crone & Dahl, 2012; Maughan, Collishaw, & Stringaris, 2013; Thapar, Collishaw, Pine, & Thapar, 2012). Approximately 30% of adolescent-onset mental health problems are attributable to childhood and/or adolescent adversity (from here 'CA') (Green et al., 2010). CA comprises negative experiences in early life such as trauma, abuse, neglect and/or bullying (McLaughlin, 2016). Up to 50% of children and adolescents growing up worldwide experience such traumatic and stressful events, making a vast percentage of the population at risk for subsequent mental illness (WHO, 2014). However, an estimated 10–25% of adolescents with CA do not develop mental health problems (Walsh, Dawson, & Mattingly, 2010). Here, we aim to investigate what sets these resilient individuals apart during a high-risk period in adolescence, by examining whether and how adolescent friendships and resilient functioning relate and change together from ages 14 to age 17.

Individuals with good mental health after CA display resilient mental health functioning. Here, we define resilience as the dynamic process of adaptation to stress: '*the maintenance or quick recovery of mental health during and following significant adversity*' (Kalisch et al., 2017, 2019). Resilience in young people with a history of CA, for whom the stressor has already occurred, can therefore be inferred from good mental health functioning after CA; we label this 'resilient functioning'. Given the negative impact of CA on a wide range of mental health disorders (including depression, anxiety, personality disorders, comorbidity), such resilient functioning after CA is characterised by *better than expected* mental health functioning across these psychological domains (Masten, 2007, 2015; Masten & Garmezy, 1985). In addition, given that differential CA experiences are thought to differentially impact mental health outcomes, it is important that such functioning is better than that of others with similar CA experiences (Rutter, 2012, 2013). Therefore, we recently proposed that resilient functioning after CA should be quantified as better mental health functioning than expected based on the degree of CA experiences (Ioannidis, Askelund, Kievit, & Van Harmelen, 2020; van Harmelen et al., 2017). In contrast to previous studies (see overviews Moreno-López et al., 2020; Ioannidis et al., 2020), such an approach does not rely on binarized presence or absence of psychopathology for the determination of individual resilience. As such, this method provides a continuous assessment of individual degree of resilient functioning that details the exact extent to which individuals are doing better (or worse) than their peers with similar CA experiences (for an extensive discussion of this method and perspective, see Ioannidis et al., 2020).

Resilient functioning after CA relies on protective 'resilience' factors (Kalisch et al., 2017; Rutter, 1985) which exist across social, cognitive, neuronal, physiological and genetic levels (Cicchetti, 2010; Dudley, Li, Kobor, Kippin, & Bredy, 2011; Karatsoreos & McEwen, 2013; Amstadter, Myers, & Kendler, 2014). For instance, mental health after CA is improved by social support (van Harmelen et al., 2016; Van Harmelen et al., 2017), recalling positive autobiographical memories, lower tendency to think negatively, higher self-esteem (Fritz, de Graaff, Caisley, Van Harmelen, & Wilkinson, 2018; Askelund, Schweizer, Goodyer, & van Harmelen, 2019), stronger prefrontral control over the limbic system and low levels of the stress hormone cortisol (Ioannidis et al., 2020; Moreno-López et al., 2020). These factors interact (Fritz, Fried, Goodyer, Wilkinson & van Harmelen, 2018) and form a complex system that is proposed to facilitate resilient mental health functioning after CA (for an in-depth discussion of this complexity perspective on resilience and its potential neurobiological mechanisms, see Ioannidis et al., 2020). Therefore, theoretically, the individual level of capacity for resilience may be measured from the assessment of stable resilience factors (e.g. genetic factors; emotion regulation capacity) before CA. However, we recently showed that social and behavioural resilience factor levels can fluctuate during adolescence (Fritz et al., 2020). As such, individual level of vulnerable and resilient functioning may also fluctuate depending on changes in resilience factors during adolescence. Investigating the temporal dynamics of resilience factors and adolescent resilient functioning will help improve our understanding of adolescent mental health resilience after CA.

Social support is a particularly important resilience factor in adolescence (Afifi & MacMillan, 2011; Ioannidis et al., 2020). Social support, the extent to which one is cared for, supported, and accepted, can be divided into received/actual support (e.g. number of friends) or perceived/quality support (e.g. how supported one feels) and can come from family, friends, pets, community ties and co-workers (Hruschka, 2010; Reblin & Uchino, 2008). Adolescence is a period of marked increase in the influence of peers (Blakemore, 2008; Blakemore & Mills, 2014; Knoll, Magis-Weinberg, Speekenbrink, & Blakemore, 2015), as such, friendship support may be an especially important resilience factor for adolescents with CA. Indeed, higher perceived friendship quality is known to be associated with lower depressive symptoms in young people with accumulated CA from peers and family members (van Harmelen et al., 2016), more resilient mental health functioning in adolescents with a history of CA (van Harmelen et al., 2017), and lower externalizing behaviours at school in youth with negative parenting behaviour (Lansford, Criss, Pettit, Dodge, & Bates, 2003). Positive friendship interactions are thought to

improve mental wellbeing in multiple ways, for instance by increasing self-esteem, fostering help-seeking and coping behaviours, lowering stress responsivity and through increasing the number of positive interactions (e.g. Cohen & Wills, 1985; Graber, Turner, & Madill, 2016; Gunnar, 2017; Hartup & Stevens 1999). Friendship quality is known to increase, on average, over the adolescent time period: between ages 13 and 17, peer relations gradually develop into stronger and more reciprocal friendships (Burnett Heyes et al., 2015). As such, it may be that resilient functioning after CA similarly increases with such normative improvements in friendship quality over the adolescent time period. However, as of yet, the mutual dynamics of adolescent resilient functioning after CA and adolescent friendship quality remain unknown. To address this, we use Latent Change Score Modelling in a large population of community ascertained adolescents (the ROOTS cohort ($N = 1238$ (Lewis, Jones, & Goodyer, 2016)). Latent Change Score modelling allows for the examination of change within constructs (i.e. within resilient functioning or friendships), the cross-domain associations (e.g. friendships and resilient functioning at age 14, or change from 14 to 17), and the examination of cross-domain coupling (i.e. the extent to which the rate of change in one domain (e.g. friendship quality) is a function of the starting point in the other domain (i.e. resilient functioning), or vice versa (Kievit et al., 2018)). Using this technique, we examined the relations and interrelations of adolescent friendship quality and resilient functioning after CA at age 14 and their change between ages 14 and 17.

We hypothesised that there would be an increase in friendship quality from age 14 to age 17 in our sample. Furthermore, based on our previous findings, we expected that friendship quality at age 14 would positively predict resilient functioning after CA at age 14, and that a positive change in friendship quality would be associated with an increase in resilient functioning after CA from age 14 to age 17.

Method

Participants

We included all participants from the ROOTS cohort ($N = 1238$; 674 girls, 564 boys, see Table 1 and sample descriptives for more details), a 3-year longitudinal study of adolescent development in participants from 18 Cambridgeshire secondary schools between November 2005 and January 2010. For Roots, 27 secondary schools from the wider Cambridgeshire region were approached (25 state and 2 private schools) and 18 schools agreed to take part. From those schools, 3762 eligible students (aged between 14 and 14 years and 11 months during the allotted 2-week interview period at each school were approached. Overall consents were received from 1238 (33%). Please see (Goodyer, Croudace, Dunn, Herbert, & Jones, 2010; Lewis et al., 2016) for more information on the ROOTS study. The Roots study was approved by the local Cambridge Research Ethics Committee [RNAG/360]. Written informed consent was obtained from both children and their caregivers.

Measures

Psychosocial Functioning

Sumscores from the following measures were assessed to investigate self-reported psychosocial functioning in the larger Roots sample ($N = 1238$) at age 14 and 17, and were therefore included in our analyses.

Table 1 Sample characteristics

		Time 1: age 14					Time 2: age 17				
Samples Total ($N = 1238$)		Included $N = 1141$	Excluded $N = 97$	t/X^2	P	BF	Included $N = 887$	Excluded $N = 351$	t/X^2, P	P	BF
Age at time 1		14.51	14.58	2.07	<0.05	0.9	14.51	14.52	0.72	0.47	10.4
Gender	Males	510	54	3.91	0.05	4	392	172	2.15	0.14	3.94
	Females	631	43				495	179			
SES	Wealthy achievers	629	33	11.2	<0.05	0.9	506	156	15.16	<0.001	7.2
	Urban prosperity	78	2				60	20			
	Comfortably off	276	15				209	82			
	Moderate means	53	2				41	14			
	Hard pressed	105	14				71	48			
	Missing		31					31			

SES, socio-economic status; *BF*, Bayes factor

The Mood and Feelings Questionnaire We used the MFQ, a 33 item self-report questionnaire, to assess current (past 2 weeks) depressive symptoms at age 14 and 17 (Angold, Costello, Messer, & Pickles, 1995). The MFQ has good internal consistency (*Chronbach's* $\alpha > 0.91$; (Thabrew, Stasiak, Bavin, Frampton, & Merry, 2018)), and higher scores indicated more severe depressive symptoms.

Revised Children's Manifest Anxiety Scale We assessed anxiety symptoms with the RCMAS self-report questionnaire (Reynolds & Richmond, 1997). Responses ranged from either always, mostly, sometimes or never. The internal consistency for the total sum score is excellent (Cronbach's $\alpha = .89$ (Muris, Merckelbach, Ollendick, King, & Bogie, 2002)), and higher scores indicated more anxiety symptoms.

Leyton Obsessional Inventory The LOI is an 11 item self-report questionnaire that measures obsessional/anxiety symptoms (Bamber, Tamplin, Park, Kyte, & Goodyer, 2002). Responses ranged from 'always', 'mostly', 'sometimes' to 'never'. The psychometric properties for the inventory are good (Cronbach's $\alpha = 86$; Bamber et al., 2002), and higher sumscores indicated more obsessionality/anxiety.

Child Behaviours Checklist The behaviours checklist is an 11 item self-report questionnaire for symptoms of antisocial behaviour based on DSM IV conduct disorder items (Achenbach, 1991). Responses on these items ranged from 'always', 'mostly', 'sometimes' to 'never'. Internal consistency of the measure has been found to be good (Cronbach's $\alpha = .89$ (Rubio-Stipec, Bird, Canino, & Gould, 1990)), and higher scores indicated more antisocial behavioural symptoms.

Ruminative Response Questionnaire We assessed ruminative responses, behaviours and thoughts which focus one's attention on depressive symptoms (Nolen-hoeksema et al. 1999, 2008), with the 22 item self-report Ruminative response questionnaire (Raes & Bijttebier, 2003)). Respondents are asked about various ruminative thoughts and whether they experience these thoughts, responses range from almost never (1) to almost always (5). As such, the RRS measures the ability to reduce negative affect and the tendency to ruminate over negative emotions, which reflect negative emotional/ maladaptive emotional behaviours. Higher total scores indicate higher ruminative symptomatology. Internal consistency of the questionnaire is excellent (Cronbach's $\alpha = .90$; Raes & Bijttebier, 2003). We included ruminative tendencies because we were interested in all assessments of psychosocial functioning.

Childhood and Adolescent Adversity

Childhood and adolescent adversity (from here 'CA') was assessed when the participants were 14 years using the Cambridge Early Experiences Interview (CAMEEI; (Dunn et al., 2011)). The CAMEEI is a semi-structured, respondent-sensitive, interviewer-led procedure that collected retrospective accounts of the quality of family environment. These recalled experiences were obtained from the main caregiver independently of the self-reported assessments carried out with their adolescent offspring. The caregivers being interviewed were biological mothers (96%, $n = 1143$), biological fathers (3%, $n = 35$), with the remaining 1% being divided into: adoptive mothers ($n = 7$), both parents ($n = 3$), and extended family members, step-mothers and step-fathers ($n = 2$) (Dunn et al., 2011). The CAMEEI focuses on three time domains of childhood: preschool years: early childhood (birth to age 5), late childhood (approximately ages 6 to 11) and adolescent CA (approximately ages 12 to 14).

Adversities reported in the CAMEEI were as follows:

1 Negative family relationships: (i) family loss and separations (includes step-parents and siblings and partners resident for more than 6 months) through divorce, death or adoption; (ii) family discord; (iii) lack of maternal affection/engagement with the proband; (iv) maternal parenting style; (v) paternal parenting style.
2 Family illness: (i) lifetime family medical illnesses sufficiently severe to impact on family life (moderate, chronic and life-threatening); (ii) lifetime psychopathology in family members.
3 Family Economics: (i) periods of unemployment; (ii) financial difficulties.
4 Childhood Maltreatment: (i) physical abuse; (ii) sexual abuse; (iii) emotional abuse. Including 'at risk' children defined as those ever having been on the Child Protection Register or for whom there was strong, but inconclusive, evidence of abuse.
5 Other Events: (i) criminality among family members; (ii) acute life events; (iii) chronic social difficulties (e.g. ongoing litigation or the demands of caring for extended family).

In previous work (Dunn et al., 2011), latent class analysis was used to identify subgroups of adolescents who had experienced different types of early adversity, based on their CAMEEI data. Latent Class Analyses (LCA) assumes that a population can be divided into mutually exclusive and exhaustive latent groups (classes) based on individual response patterns from a set of measured items. Identifying these latent classes is of value because different groups have different characteristics, different prognoses and therefore different aetiologies. We found support for four mutually exclusive CA

subgroups. The largest class (the 'Optimal class') contained those with a low (< 13%) probability of any adversity at any time point (n = 784, 69% of the sample). The second ('Abberant Parenting'; n = 76, 7% of the sample) had a high probability (70–100%) of inconsistent and atypical parenting by both parents (e.g. lax, very strict, cruel to be kind, hitting—all of which showed low prevalence) and a lower probability (8–17%) of any adversity at any time point. The third class (the 'Discordant class'; n = 213, 19% of the sample) had a high probability (47%) of family discord (e.g. marital disagreements) and a 11–39% probability of any adversity at any time points. They also showed elevated rates of family loss, financial difficulties and maternal psychiatric illness. The fourth class (the 'Hazardous class'; n = 66, 6% of the sample) had 50–90% probability of any adversity at any time point) with a high probability (60%) of physical and/or emotional abuse. These classes were replicated at each time point (birth to age 5; ages 6 to 11; and ages 12 to 14) (Dunn et al., 2011).

We computed an overall CA score by summing scores on early childhood (birth to age 5), late childhood (ages 6 to 11) and adolescent (and ages 12 to 14) CA experiences. To do so, we recoded the CA classes (Optimal =1, Aberrant =2, Discordant = 3, and Hazardous = 4), and computed an overall CA score over the three time periods (early childhood + late childhood + and adolescent). Note that this overall CA score had a high correlation with CA at all three time periods: early childhood (r = .79, $t(1137) = 44.92$, $p < .001$), late childhood (r = .85, $t(1137) = 54.31$, $p < .001$), and adolescent CA (r = .78, $t(1137) = 41.98$, $p < .001$). Finally, to examine whether CA experiences at different developmental time periods may show differential effects, we repeated all analyses focussing on early childhood CA, late childhood CA or adolescent CA only. All main findings remained in these analyses.

Friendship Quality

Self-reported perceived quality of friendship quality (from her for brevity; friendships) was assessed at ages 14 and 17 with the Cambridge Friendships Questionnaire (CFQ), which is derived from a semi-structured interview on social relationships (Goodyer, Wright, & Altham, 1989). See Supplemental page 5 for the complete questionnaire used. The CFQ is invariant, has adequate test retest reliability (Kappa = .80) and has external validity (Memarzia et al., in preparation). The 8-item CFQ assesses the number, availability and quality of friendships (e.g. 'Do you feel that your friends understand you?', 'are you happy with the number of friends that you've got at the moment', 'can you confide in your friends', 'do you have arguments with your friends that upset you?'. Higher scores indicate better self-reported overall quality of friendships.

Statistical Approach

All analyses were conducted in R version 3.5.1 (2018-07-02)—"Feather Spray", using the Lavaan package (Rosseel, 2012).

Calculating Degree of Resilient Functioning

At age 14 and 17, we calculated the degree of resilient functioning for each individual in the sample. Specifically, in line with our previous method (van Harmelen et al., 2017), we calculated a multi-modal composite score for psychosocial functioning (PSF) by conducting a principal component analysis (PCA) on standard-normally transformed individual total scores on the MFQ, RCMAS, S-LOI, BEH and RRQ questionnaires. We computed this PCA at age 14 and again at age 17. To ensure measurement invariance (or rather, component invariance—see for more details Timmerman (2001)) of the scores, we imposed the set of the first component loadings from the PCA at age 14. In this PCA, scores were rescaled to standard normality at age 14, and scaled using the data at age 17. In both PCAs, the resulting first component scores were inverted so that higher scores indicated better psychosocial functioning (PSF). Next, we regressed PSF first component scores on this composite CA score to test for possible linear, quadratic or cubic associations, this model was conducted at age 14 and at age 17. We tested for these differential associations for two reasons; stress inoculation theory (Rutter, 2012) suggests that the association between CA and PSF is non-linear with moderate stress relating to better outcomes when compared to low or severe stress. Second, in van Harmelen et al., 2017, we found support for a quadratic association between CA and resilient functioning. From these associations, we extracted the residual scores for the best fitting model as these reflect the extent to which an individual has better, or worse, psychosocial functioning than others with similar CA experiences ((Van Harmelen et al., 2017); Fig. 2a and b). As such, these residual scores reflect individual degree of resilient functioning, with lower scores reflecting vulnerable psychosocial functioning and higher scores reflecting more resilient psychosocial functioning. These resilient functioning scores were utilized in all below analyses.

Investigating the Association between Friendship Quality ('Friendships') and Resilient Functioning from Age 14 to Age 17

To take into account differences in follow-up time between waves 1 and 3, we rescaled both resilient functioning and friendships at time 2 in line with Ferrer & McArdle, 2004, to ensure scores are adjusted for differences in the time between time 1 and time 2 for all individuals (median = 1102 days, range = 735–1731 days). We then examined cross-sectional

associations between resilient functioning and adolescent friendships. To examine whether we should include known confounds for mental health and resilient functioning (age, gender, SES) in our analyses, we conducted simple regressions testing for the relationship between these variables and resilient functioning at age 14 and 17, and friendships at ages 14 and 17. We only found support for gender effects, and therefore, in the below analyses, we examined whether the results were similar or distinct in boys versus girls by fitting and comparing multi-group models.

To examine the change in resilient functioning, we ran a series of Latent Change Score Models (Kievit et al., 2018). In these analyses, we used full information maximum likelihood estimators in order to include the maximum available data in our cohort at times 1 ($N = 1141$) and 2 ($N = 887$). As such models (using observed scores) are saturated, we report and focus our discussion on the key associations within the model, rather than model fit, which will be always be perfect given 0 degrees of freedom. Next, in post hoc exploratory analyses, we examined whether results were similar or distinct for boys vs. girls by comparing a multi-group model where all parameters were estimated freely within each group, to a model where key parameters were constrained to be equal, and compared model fit between the two multi-group models using likelihood ratio tests. Next, we implemented the same series of model steps to examine the change in friendships from ages 14 and 17. For this model, gender effects were not specifically examined, as gender had no association with friendships at age 14 or 17 (see Table S1).

Finally, to examine how friendships and resilient functioning changed together between ages 14 and 17, we fitted a bivariate latent change score model. This model allowed us to examine the reciprocal influences and correlations between friendships and resilient functioning at ages 14 and 17. This model also allowed us to fit coupling parameters that quantify the extent to which the rate of change in one domain (e.g. friendships) is a function of the 'starting point' in the other domain (e.g. resilient functioning), and vice versa. Next, in post hoc exploratory analyses, we examined whether results were similar or distinct for boys vs. girls by comparing a multi-group model where all parameters were estimated freely within each group, to a model where key parameters were constrained to be equal, and compared model fit between the two multi-group models using likelihood ratio tests.

Results

Sample Descriptives

Table 1 shows that, at age 14, $N = 1141$ had full data on all measures included for the analysis. When compared to those who did not have full data ($n = 97$), this sample was slightly younger ($M_{age} = 14.51$ vs. 14.58 ($t(69.96) = 2.07$, $p = .04$). The two groups varied slightly on socio-economic status (SES, $\chi^2(4) = 11.20$, $p = .02$) and gender distribution ($\chi^2(1) = 3.90$, $p = .05$), see Table 1 for details). At age 17, we had full data on all measures used for $N = 887$ individuals. When compared to those who did not have data at age 17 ($N = 351$), this sample had a similar age at time 1 ($t(518.61) = .72$, $p = .46$), and gender distribution ($\chi^2(1) = 2.15$, $p = .14$), but had a different SES distribution ($\chi^2(4) = 15.16$, $p < .05$), see Table S1 for details.

Quantifying Individual Degree of Psychosocial Functioning at Age 14 and Age 17

The PCA for psychosocial functioning resulted in a first component that explained 66% of the variance across all measures. After inversion for ease of interpretation, higher scores on this first component reflected better psychosocial functioning. The first component factor loadings were as follows:

$$0.502*\text{MFQ} + 0.51*\text{RCMAS} + 0.44*\text{LOI} + 0.30*\text{BEH} + 0.44*\text{RRQ}$$

These component scores were extracted to reflect individual current psychosocial functioning at age 14. PSF at age 14 and 17 were strongly positively related ($r = .47$, $t(849) = 15.36$, $p < 2.2e\text{-}16$, 95% CI = .41–.52).

Quantifying Individual Degree of Resilient Functioning

At age 14, a linear model regressing psychosocial functioning on CA provided good fit (adjusted $R^2 = .03$, $F(1,1088) = 39.48$ $p < 4.78e\text{-}10$, Est = − 0.13, SE = 0.02, $t = -6.28$, $p < 4.78e\text{-}10$, AIC = 4334.36). A quadratic term did not improve this fit ($Est = -.005$, $SE = .01$, $t = -0.59$, $p = .55$, AIC = 4336.00), whereas a cubic model provided the best fit ($R^2 = .037$, $F(3,1086) = 15.24$, $p < 1.018e\text{-}9$, Est = − .01, SE = .003, $t = -2.39$, $p < .017$, AIC = 4332.26). A likelihood ratio test suggested that there was only weak evidence that a cubic model improved model fit over the linear model (SSQ = 18.88, F (1086) = 3.05, $p = .05$). At age 17, a linear model provided good fit ($R^2_{adj} = .02$, $F(1,854) = 22.78$, $p < 2.13e\text{-}06$, Est = 10.11, SE = .02, $t = -4.77$, $p < 2.13e\text{-}06$, AIC = 3246.77), a quadratic term did not contribute beyond the linear component (Est = .01, SE = .01, $t = 1.02$, $p = .31$, AIC = 3247.73), and neither did a cubic term (Est = − .01, SE = .003, $t = -1.67$, $p = .09$, AIC = 3246.92). Given the marginal benefits to model fit, and the unstable properties (i.e. the vulnerability to outliers), of adding non-linear components, and the fact that linear models fitted our data adequately at age 14

and at age 17, we relied on the linear model for further analyses at both ages (Fig. 1). There was a strong association between resilient functioning at age 14 and age 17 ($r = .47$, $t(822) = 15.46$, $p < 2.2e\text{-}16$, 95% CI = .42–.52).

Univariate Associations between, Age, Gender, SES, Resilient Function and Friendships

There was a strong positive association between friendships at age 14 and resilient functioning at both age 14 and 17 (Fig. 1, Table S1; age 14; $r = .43$, $t(1063) = 15.45$, $p < 2.2e\text{-}16$, 95% CI = .38–.48; age 17; $r = .23$, $t(826) = 6.86$, $p < 1.312e\text{-}11$, 95% CI = .17–.29). Table S1 shows that, in line with van Harmelen et al., 2017, boys had higher resilient functioning than girls at ages 14 and 17. There was no association between gender and friendship quality at age 14 or 17. Finally, there was no association between older age, or higher SES, with resilient functioning at age 14 or age 17. As gender was significantly related to resilient functioning, we conducted follow-up analyses specifically testing whether our findings were similar or distinct in boys vs. girls.

Change in Resilient Functioning from Age 14 to Age 17

There was no mean change in resilient functioning from age 14 to age 17 (Est = 0.04, SE = 0.06, $Z = -0.74$, Table 2). However, there were significant individual differences in resilient functioning at age 14, as indicated by significant intercept variance term (Est = 3.15, SE = 0.17, $Z = 18.76$). Additionally, the variance for the slope between ages 14 and 17 was a significant (i.e. rate of change: Est = 2.93, SE = 0.18, $Z = 15.82$), suggesting that there were individual differences in the rates of change of resilient functioning over time. We also found a negative self-feedback effect between resilient functioning at age 14 and change over time (Est = −1.68, SE = 0.15, $Z = -11.14$), suggesting that those high in resilient functioning show a decline in their functioning over time, whereas those low in resilient functioning increased in their functioning over time. Such a pattern of regression to the mean is often observed. Multi-group models testing for gender effects revealed that the associations were generally similar for boys and girls, with one exception: mean resilient functioning at age 14 was considerably lower for girls (Est = −0.35, SE = 0.07) than for boys (Est = 0.43, SE = 0.07). Constraining the mean resilient functioning at age 14 to be equal across the groups led to a considerable drop in model fit ($\Delta\chi^2(1) = 53.45$, $p < 0.01$), supporting our findings that girls showed lower mean resilient functioning at age 14.

How Do Friendships Change from Age 14 to Age 17?

When investigating change within friendships from age 14 to 17, the model revealed that there was a mean increase in friendship from age 14 to age 17. As before, there were pronounced individual differences in both baseline friendships (Est = 17.67, SE = 0.98, $Z = 17.96$; Table 3) and the change in friendships (Est = 18.63, SE = 1.08, $Z = 17.20$). There was a negative covariance between friendships and rate of friendship increase (Est = −12.01, SE = 0.85, $Z = -14.21$), suggesting that those with better quality friendships at age 14 tended to show less friendship quality improvement, whilst those with lower quality friendships showed an increase in friendship quality over time.

The Interplay Between Friendships and Resilient Functioning Between Ages 14 and 17

Next, we examined the interplay between both domains in a bivariate latent change score model. First, we observed a strong positive correlation between resilient functioning and friendships at age 14 (Fig. 3; Est = 3.23, SE = 0.31,

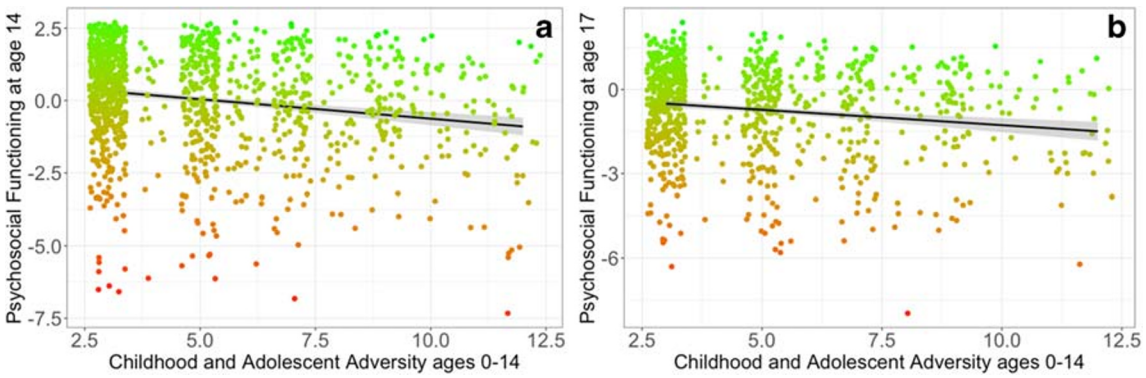

Fig. 1 Association between Childhood and Adolescent Adversity and resilient functioning at age 14 (**a**) and 17 (**b**)

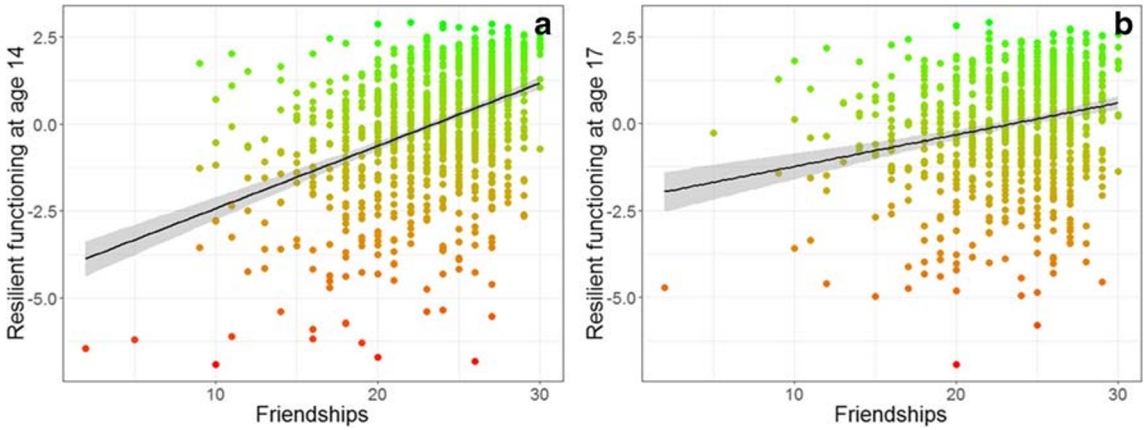

Fig. 2 Associations between resilient functioning and friendships at age 14 (**a**) and 17 (**b**)

$Z = 10.34$, Table 4), indicating that those with more resilient functioning had higher self-reported quality of friendships. Next, we found that higher quality friendships at age 14 was *not* associated with greater increases in resilient functioning between age 14 and 17 (Est = 0.02, SE = 0.02, $Z = 1.2$). In contrast, we observed a robust association in the other direction: those with higher resilient functioning at age 14 showed *greater gains* in friendships between age 14 and age 17 (i.e. Est = 0.27, SE = 0.07, $Z = 3.91$). In other words, those with high resilient functioning at age 14 showed larger gains in friendships between ages 14 and 17, independent of their friendship quality levels at age 14. Finally, and intriguingly, even after taking into account this coupling, as well as the self-feedback pathways, the changes in resilient functioning and friendship quality were strongly positively correlated (Est = 1.64, SE = 0.23, $Z = 7.01$). In other words, changes in friendship quality and resilient functioning over a 3-year period went hand-in-hand, even when taking into account other dynamic effects. Multi-group models revealed that these associations were similar for boys and girls (See Supplemental information Table S2 and Figure S1). Indeed, model fit was unchanged in models where coupling parameters ($\chi^2 = .91$, $p = .64$) and variance parameters were constrained to be equal across boys and girls ($\chi^2 = 2.4$, $p = .87$).

Discussion

We aimed to examine the association between mental health resilient functioning, friendship quality and their mutual change from age 14 to 17 years. We replicated our earlier cross-sectional findings in a different sample that friendship quality is positively related with resilient functioning after CA ($r = .43$ in $N = 2890$ ages 14–24, van Harmelen et al., 2017), in this independent cohort of young people (i.e. $r = .43$ at age 14 in $N = 1141$). However, in contrast to our earlier findings, and contrary to our hypothesis, greater friendship quality at age 14 was not associated with greater *gains* in resilient functioning from age 14 to age 17. Rather, we found that higher resilient functioning at age 14 is associated with greater improvements in *friendship quality* from age 14 to age 17. However, we also found that the change in friendship quality was strongly related to change in resilient functioning after CA. This was found after taking into account the regression pathways within constructs (i.e. friendship quality at age 14 predicting friendship quality age 17; resilient functioning at age 14 predicting resilient functioning age 17), and coupling pathways (i.e. friendship quality and resilient functioning at age 14 and 17). Furthermore, we found that, although girls had lower resilient functioning, all *dynamic associations* reported above were not different for boys and girls. In sum, we found that improvements in friendship quality and resilient functioning go hand-

Table 2 Parameter estimates latent change model for resilient functioning

Parameter	Est	SE	Z	P	CI lower	CI upper	Std All	Lavaan notation
Resilience change intercept	− 0.04	0.06	− 0.74	0.46	− 0.16	0.07	− 0.03	dresT1~1
Mean resilience at age 14	0.00	0.05	0.00	1.00	− 0.10	0.10	0.00	resT1~1
Resilience change variance	2.93	0.19	15.82	< 0.001	2.57	3.29	1.00	dresT1~~dresT1
Resilience at age 14 variance	3.11	0.17	18.76	< 0.001	2.78	3.43	1.00	resT1~~resT1
Resilience at age 14- change (14–17) covariance	− 1.68	0.15	− 11.14	< 0.001	− 1.98	− 1.38	− 0.56	dresT1~~resT1

Table 3 Parameter estimates latent change model for friendship change

Parameter	Est	SE	*Z*	*P*	CI lower	CI upper	Std All	Lavaan notation
Friendship change intercept	1.25	0.14	9.18	< 0.001	0.98	1.51	0.29	dfriendst1~1
Mean friendships at age 14	23.54	0.12	188.49	< 0.001	23.29	23.78	5.60	friendst1~1
Friendship change variance	18.63	1.08	17.20	< 0.001	16.51	20.76	1.00	dfriendst1~~dfriendst1
Friendships at age 14 variance	17.67	0.98	17.96	< 0.001	15.74	19.60	1.00	friendst1~~friendst1
Friendship at age 14 -change (14–17) covariance	− 12.01	0.85	− 14.21	< 0.001	− 13.66	− 10.35	− 0.66	dfriendst1~~friendst1

in-hand, even when taking into account baseline levels of both, and the change *within* friendship quality or resilient functioning over time, as well as the association between resilient functioning and change in friendship quality over time. These findings suggest that changes in adolescent friendship quality and resilient functioning after CA seem inextricably intertwined.

We found that mean levels of resilient functioning did not change from age 14 to age 17 in our sample. However, this does not imply that no change was happening: we observed pronounced individual differences in level of resilient functioning at age 14, as well as individual differences in the change over time between ages 14 and 17. Those with higher resilient functioning at age 14 tended to show a decrease in their functioning, whereas those with low resilient functioning at 14 tended to show an increase over the following 3 years. These findings are suggestive of a regression to the mean. Specifically, if scores are randomly and independently distributed with a mean of X, then another assessment of these scores at time 2 will result in a decrease or increase towards X, leading to the absence of changes on the group level. Indeed, we did not find average resilient functioning changes at a group level. However, although resilient functioning at age 14 and age 17 were strongly related ($r = 0.47$), they were not perfectly related. Indeed, we found that friendship quality and resilient functioning were strongly related, both at age 14 and in their change from age 14 to 17. Together, these findings do not align with the notion that resilience is a static trait that remains stable over time. Rather, our findings are in line with the suggestion that resilient functioning is dynamic and fluctuates over time (Cicchetti & Rogosch, 2009; Rutter, 2012; Kalisch et al., 2017), and suggest that resilient functioning after CA depends (in part) on adolescent friendships.

There was an overall increase in self-reported quality of friendship quality from age 14 to age 17 in our sample, which is in line with the notion that friendship quality become stronger over the adolescent period (Burnett Heyes et al., 2015). However, our model suggested that there were significant individual differences in the level of friendship quality at age 14 and in the change of friendship quality from age 14 to age 17. Indeed, Fig. 3A shows significant variance of individual friendship quality change scores, with some individuals showing improvements, and others showing a decline, from age 14 to age 17. These findings highlight the fact that it is critical to examine individual differences in adolescence (Foulkes & Blakemore, 2018), as our data indicate that increases found on a group level do not generalise to the individual level in our sample. Rather, our findings are suggestive of important

Table 4 Parameter estimates bivariate latent change model for resilient functioning and friendships

Parameter	Est	SE	*Z*	*P*	CI lower	CI upper	Std All	Lavaan notation
Friendship change intercept	18.37	0.79	23.22	< 0.001	16.82	19.93	4.26	dfriendst1~1
Mean friendships at age 14	23.53	0.13	188.18	< 0.001	23.28	23.77	5.59	friendst1~1
Friendship change variance	10.28	0.68	15.13	< 0.001	8.95	11.61	0.55	dfriendst1~~dfriendst1
Friendships at age 14 variance	17.71	0.99	17.94	<0.001	15.78	19.64	1.00	friendst1~~friendst1
Friendship at age 14-change (14–17)	− 0.73	0.03	− 22.55	< 0.001	− 0.79	− 0.66	− 0.71	dfriendst1~~friendst1
Resilience change intercept	− 0.48	0.35	−1.37	0.17	− 1.16	0.21	−0.28	dresT1~1
Mean resilience at age 14	− 0.01	0.05	− 0.11	0.91	− 0.11	0.10	0.00	resT1~1
Resilience change variance	2.03	0.13	16.23	<0.001	1.79	2.28	0.70	dresT1~~dresT1
Resilience at age 14 variance	3.12	0.17	18.77	<0.001	2.79	3.44	1.00	resT1~~resT1
Resilience at age 14 -change (14–17)	− 0.55	0.04	− 15.48	< 0.001	− 0.62	− 0.48	− 0.57	dresT1~~resT1
Coupling: resilience to friendships	0.27	0.07	3.91	< 0.001	0.13	0.40	0.11	dfriendst1~resT1
Coupling: friendships to resilience	0.02	0.02	1.20	0.23	−0.01	0.05	0.04	dresT1~friendst1
Covariance at age 14	3.23	0.31	10.34	<0.001	2.61	3.84	0.43	resT1~~friendst1
Correlated change	1.64	0.23	7.01	<0.001	1.18	2.09	0.36	dresT1~~dfriendst1

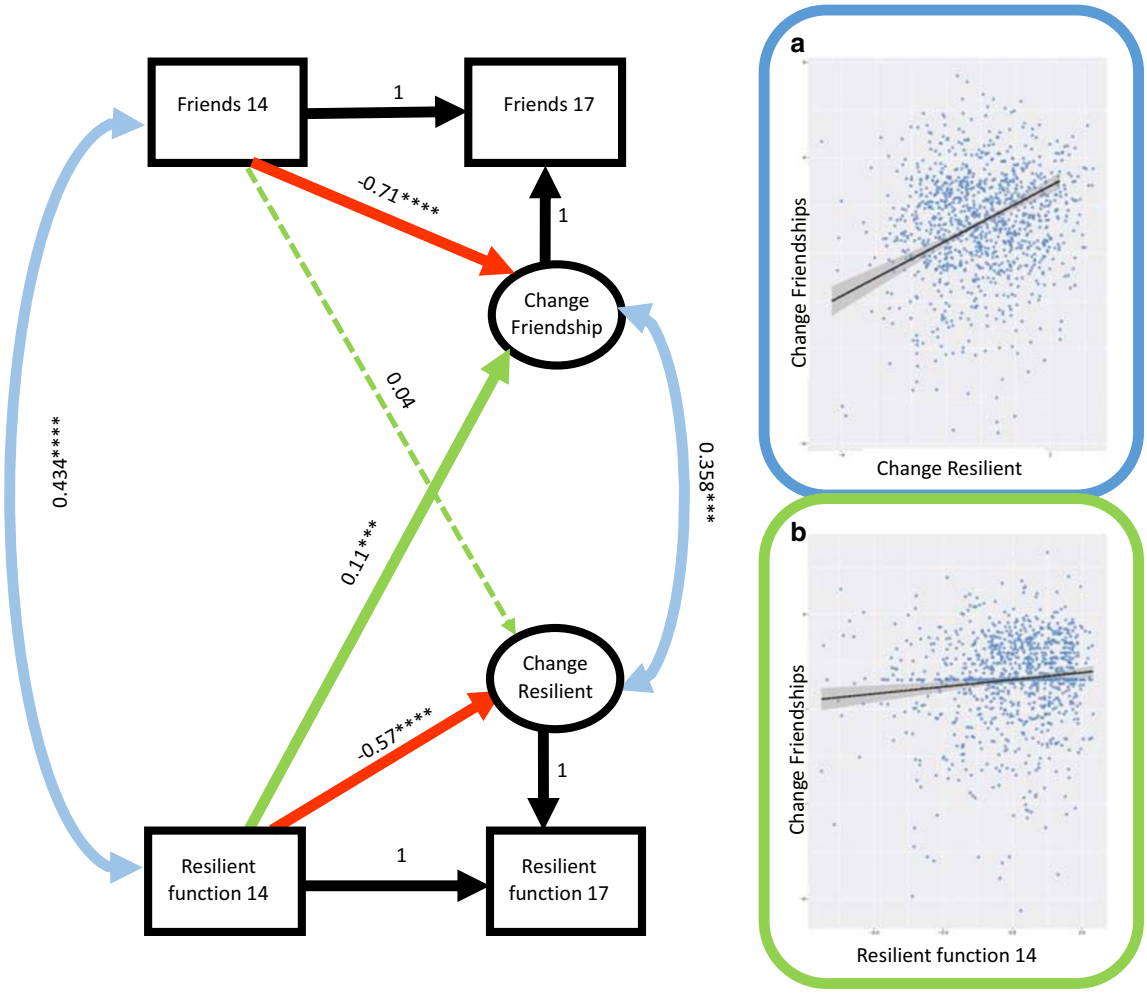

Fig. 3 Bivariate latent change score model. Only key parameters are shown as fully standardised estimates—for all parameters see Table 2. Resilient function 14 (17): resilient functioning assessed at age 14 (17). Change resilient: latent variable modelled as the change in resilient functioning between age 14 and age 17. Friends 14 (17) self-reported friendship quality assessed at age 14 (17). Change friendships: the latent variable representing the change in friendships modelled on friendship quality at age 14 and 17. Blue lines indicate cross-domain undirected associations, green lines indicate directed cross-domain regressions, red lines indicate directed within domain associations, black lines indicate associations where parameter estimates were fixed. Circles indicate latent variables and squares indicate observed variables. **a** Correlation between change in friendships and change in resilient functioning; **b** correlation between resilient functioning at age 14 and the change in friendships from age 14–17. ***$p < .001$

individual differences that influence the level of friendship quality experienced across adolescence. Indeed, we found that adolescents with more resilient functioning had better quality friendships, and vice versa, at age 14. In addition, we found positive coupling between resilient functioning at age 14 and change in friendship quality between age 14 and 17, suggesting that adolescents with high resilient functioning at age 14 showed an *improvement* in friendship quality between age 14 and 17, regardless of their initial friendship levels. These findings resonate with those showing that psychosocial functioning is predictive of friendship interactions in early adolescence; higher self-esteem is associated with more integrated social networks in 12-year-old girls (Pachucki, Ozer, Barrat, & Cattuto, 2015), and depressive symptomatology negatively impacts peer interactions in children (Rockhill et al., 2007). Together with our finding that a change in friendship quality from age 14 to age 17 was positively associated with a change in resilient functioning in this period, and vice versa, our findings corroborate earlier work showing that adolescent resilient functioning and friendship quality are strongly related. In addition, our findings extend the literature by showing that a change in resilient functioning after CA (or friendships) from age 14 to age 17 may result in a similar change in friendship quality (or resilient functioning after CA) over this period of life.

Friendship quality did not predict a change in resilient functioning from age 14 to age 17. This appears to contradict previous findings that adolescent friendship quality improves later resilient functioning after CA (Van Harmelen et al., 2017), and improve mental health in general population

samples (Colarossi & Eccles, 2003; Narr, Allen, Tan, & Loeb, 2019; Skrzypiec, Slee, Askell-Williams, & Lawson, 2012). However, on average, the participants in these samples were older (i.e. > 15 years), suggesting that friendship quality may be more beneficial to mental health in later adolescence. Indeed, in late childhood, social influence did not impact mental health in a sample of 12-year-olds (Pachucki et al., 2015). The idea that friendship quality is more predictive of mental health in later adolescence is in line with the idea that friendship quality become increasingly more stable and reciprocal between ages 13 and 17 (Burnett Heyes et al., 2015). Alternatively, as this is the first study that utilized latent change score modelling to investigate the specific relations and interrelations of friendship quality and resilient functioning change over the teenage years, the results in previous studies might reflect the strong coupling between friendship quality and resilient functioning that we observed at baseline and their change.

We found a strong association between baseline and change of resilient functioning after CA and friendship quality in young people aged 14 to 17. This association may rely on the neurocognitive mechanisms that facilitate positive peer connections. We recently showed that, whereas CA is associated with increased behavioural and neural sensitivity to peer exclusion (Van Harmelen et al., 2014), resilient adolescents following CA do not have altered mood or neural responses in response to negative peer feedback from peers (Fritz et al., 2020). These findings suggest that resilient adolescents with CA may have improved skills and resources to cope with negative interactions with their peers. Indeed, a recent review of the literature suggests that resilient adults with a history of CA show increased resting state functional connectivity in a brain network associated with cognitive control (i.e. the Central Executive Network (Moreno-López et al., 2020). Cognitive control is a key tenet of executive functioning and refers to the ability to regulate thoughts and actions with goal relevant material (Braver, 2012). As such, cognitive control of emotions is pivotal in successful emotion regulation (Ochsner & Gross, 2005). Indeed, poor cognitive control of emotions was related to difficulties with emotion regulation and mental health problems in young adolescents (age 11 to age 14) without adversity (Schweizer et al., 2016). Such problems with emotion regulation negatively affect social interactions; depressed children were found to evoke negative peer interactions through displaying more negative emotions (Rockhill et al., 2007). In contrast, resilient adolescents showed enhanced emotion regulation capacity underpinned by reduced recruitment of mPFC and downregulation of amygdala activity in response to negative stimuli in resilient adolescents (Schweizer et al., 2016). Perhaps increased cognitive control and improved emotion regulation helps resilient adolescents to regulate their responses to negative feedback, evoking more positive peer interactions and subsequently positive friendship quality in adolescence. Examining the specific mechanisms of the association between resilient functioning after CA and the social environment should be the subject of future studies.

We found that, at ages 14 and 17, boys had higher resilient functioning than girls. These findings are consistent with our previous report that male gender predicts later resilient functioning (van Harmelen et al., 2017). These findings further support those of poorer mental health in adolescent girls (Thapar et al., 2012). In line, a recent cross-national study on 73 countries worldwide reported that adolescent girls report lower life satisfaction, hedonia and eudaemonic wellbeing as well as more psychological distress (Campbell, Bann & Patalay, 2020). Despite having lower resilient functioning, we did not find evidence for differential friendship quality at age 14, or age 17 in boys vs. girls. Furthermore, we found similar associations between friendship quality and resilient functioning at age 14 and in their rate of (mutual) change between age 14 and 17. Thus, despite having lower resilient functioning, this does not seem to impact friendship quality in adolescent girls. Other factors, such as the emergence of gonadal hormone secretion in adolescence, may underpin higher vulnerability in girls in general (Wright, Hostinar, & Trainor, 2019). Perhaps our findings of equal friendship quality despite lower resilient functioning in girls may, in part, be due to the fact that girls report to have more positive connections with parents, teachers and adults outside the school, higher levels of communication, higher empathy and more help-seeking behaviours when compared to boys (Sun & Stewart, 2007). Regardless, our findings suggest that interventions that increase either adolescent resilient functioning, or friendship quality, may be equally beneficial in boys and girls.

Limitations

The current findings should be interpreted with the following limitations in mind. First, CA was retrospectively assessed through an interview with the primary caregiver at age 14, potentially resulting in an underreporting of CA (Dunn et al., 2011; Goodyer et al., 2010), which would lower the predictive validity of CA in our study. However, at the time of interview, the assessor used time intervals (early, middle, and late childhood), which enhanced recall and report accuracy of CA (Dunn et al., 2011). However, caregiver vs. self-report, as well as prospective and retrospective reports on CA relate differently to mental illness as well as to different populations of individuals with CA (Newbury et al., 2018; Baldwin et al., 2019). In addition, it may be that resilient functioning after CA depends on the type of adversity experienced (in accordance with the deprivation vs. threat model of

psychopathology (McLaughlin, Sheridan, & Lambert, 2014)). CA in our models was based on latent grouping across a variety of differential experiences (in line with studies showing that different types of CA often co-occur (Lacey & Minnis, 2020)), and we are therefore unable to examine whether resilient functioning depends on the specific types of CA. In addition, our sample SES was above the UK average (Goodyer et al., 2010), and the sample reported only mild to moderate CA experiences (Walsh et al., 2014). Furthermore, resilient functioning in our sample was quantified as the level of psychosocial functioning given to the degree of CA experienced. As such, resilient functioning is relative to CA experienced in our sample, and it is unclear whether and how our findings generalize to other samples. Furthermore, our conceptualisation results in a strong association between resilient functioning and psychosocial functioning. Given the low variance explained by CA on psychosocial functioning in our sample, results will likely be similar for psychosocial functioning (without taking CA into account). However, this would not affect the key arguments here: that friendship quality and resilient psychosocial functioning may change together in adolescence. Furthermore, although Latent Change Score Modelling aims to test hypothesised causal relations, and we utilised a longitudinal design, this is not an experimental study. As such, our findings cannot be considered direct evidence for causal effects. Furthermore, our study is based on two time points, which is very minimal for assessing change and reciprocal associations in constructs over time. Finally, the associations reported are small to typical (Gignac & Szodorai, 2016) at best, which is in line with our conceptualization as resilient functioning as the end result of complex dynamic interactions between a manifold of protective factors residing on genetic, neurobiological, behavioural and social levels (Ioannidis et al., 2020). In sum, future studies should investigate whether our findings generalize to other psychosocial and CA assessments, friendship and mental health assessments over more than 2 time points, as well as to different populations (e.g. with lower SES, more severe CA and/or prospective CA experiences), and whether the reported relations hold in experimental studies testing causal relations of our findings.

Conclusions

We examined how friendship quality and resilient functioning after CA inter-relate and change together from age 14 to age 17. We found a strong link between these domains at age 14, although friendship quality at 14 did not predict higher resilient functioning at 17. We found that increased resilient functioning at age 14 improves friendship quality change from age 14 to age 17. In addition, the change in friendship quality from age 14 to 17 was positively related with the change in resilient functioning over this time. In sum, our findings suggest that adolescent resilient functioning after CA and friendship quality between ages 14 and 17 inter-relate and change together. This suggests that improvements in friendship quality between ages 14 and 17 might lead to improvements in resilient functioning, and vice versa. Future research should examine whether improving friendships, or resilient functioning, within this timeframe may therefore benefit this vulnerable adolescent group.

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Data Availability Code for this manuscript can be found here. As we do not have consent to publish our data online, data can be requested from the Cambridge repository upon reasonable request.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

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